

***HIGH-RESOLUTION RETRIEVAL OF CLOUD LIQUID WATER PROFILES USING
THE COLLOCATED ARM Ka- AND W-BAND RADARS***

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ABSTRACT

Most of the existing radar algorithms for retrieving cloud liquid water content (LWC) make use of empirical Z-LWC relationships that are based on various questionable assumptions. They work poorly under precipitating conditions, and the uncertainty in the retrievals is difficult to quantify. We have not seen much progress on these approaches for decades. On the other hand, the dual-frequency radar attenuation approach makes no assumptions about the cloud drop size distribution and is based on simple physics. Thus, this approach can provide accurate (unbiased) retrieval of cloud LWC. Previous studies showed that, however, the precision of the dual-frequency retrieval is very poor; either a long radar dwell time or averaging over many range gates is needed to improve the retrieval precision. This poster shows that, by virtue of advanced mathematical inversion techniques like total variation regularization, accurate retrieval of vertically resolved cloud LWC at high temporal and spatial resolution is achievable using operational cloud radars. The validity of this dual-frequency approach is demonstrated using the co-located Ka-band and W-band cloud radars operated by the Atmospheric Radiation Measurement (ARM) Climate Research Facility. The liquid water path calculated from the radars agrees closely with that from a microwave radiometer, with mean difference of 70 gm⁻² for precipitating clouds and 30 gm⁻² for non-precipitating clouds. Comparison with lidar measurements reveals that the dual-frequency retrieval also reasonably captures the cloud base height of drizzling clouds -- something that is very difficult to determine from radar reflectivity alone. We have applied the dual-frequency approach to the ARM radar observations from 2006 to 2008 and have produced a three-year cloud LWC vertical profile data set.

This poster will be displayed at ASR Science Team Meeting.